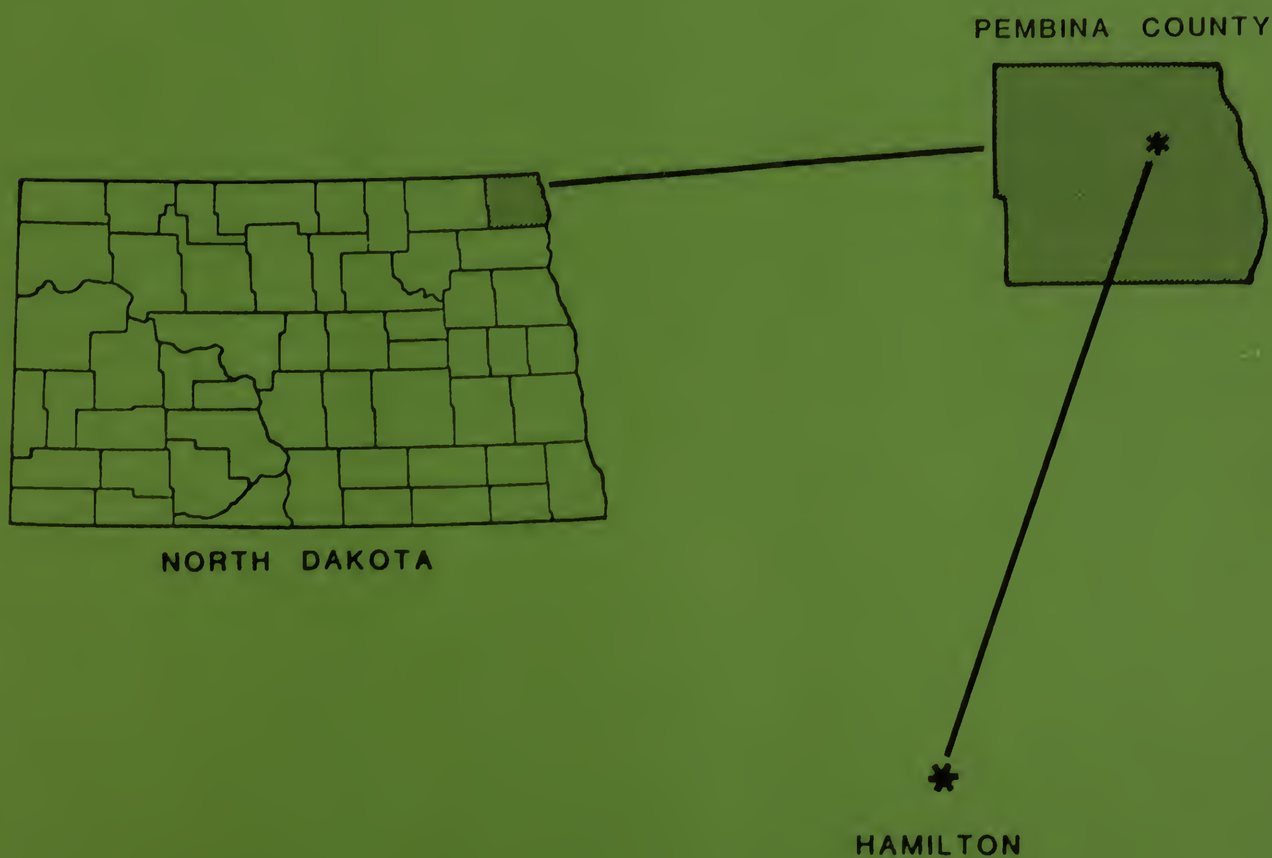
United States
Department of
Agriculture

Soil
Conservation
Service

Bismarck
North Dakota

HAMILTON FLOOD PLAIN MANAGEMENT STUDY PEMBINA COUNTY, ND

Prepared for the City of Hamilton and the Pembina County Water Resource District



FLOOD PLAIN MANAGEMENT STUDY

ON

AN UNNAMED TRIBUTARY OF THE TONGUE RIVER

AND

ADJACENT CRITICAL FLOOD PLAIN AREAS

IN THE VICINITY OF HAMILTON, NORTH DAKOTA

Prepared By

United States Department of Agriculture
Soil Conservation Service
Bismarck, North Dakota

For the

CITY OF HAMILTON, NORTH DAKOTA

AND THE

PEMBINA COUNTY WATER RESOURCE DISTRICT

In Cooperation with the
Pembina County Soil Conservation District
and the
North Dakota State Water Commission

JUNE 1986

F O R E W O R D

This report defines the flood characteristics along and adjacent to an unnamed tributary of the Tongue River in Pembina County, North Dakota. Land uses along the stream are transportation, residential, commercial, industrial, agricultural, recreational and wildlife. Despite moderate agricultural damage by floods in previous years, there is increasing pressure for development of the flood plain.

This cooperative report was prepared for the guidance of local officials in planning land use and regulating development within the flood plain. The 10-, 50-, 100- and 500-year frequency flood events were selected to represent degrees of major flooding that could occur in the future. The 100-year [1/] and the 500-year [2/] floods are frequencies considered for planning land use and development in the flood plain. Potential flooded areas are defined by flood hazard photomaps that show the approximate areas subject to inundation. Flood profiles show the water surface elevations for the selected events. Typical valley cross sections are presented to indicate ground levels across the width of the valley with the overlying flood depths. The flood profiles and flooded area photomaps are based on conditions at the time of the study (1985).

This report does not imply any federal authority to zone or regulate use of the flood plain; authority to zone and regulate rests with state or local governments. Technical data is provided for the potential future adoption of local land use controls to regulate flood plain development. Since this report identifies flood problems, it will give guidance for the development,

1/ A flood which has a 1 percent chance of being equaled or exceeded in any year (also called "base" flood).

2/ A flood which has a 0.2 percent chance of being equaled or exceeded in any year.

with environmental considerations, of flood damage reduction techniques such as flood control structures, channel improvement, removal of obstructions, and flood proofing for use in an overall Flood Plain Management Program. Although generally not considered effective in reducing flood damages for major runoff events; such items as wetland restoration, conservation land treatment and proper land use have a positive affect on downstream flood reduction as well as environmental and agronomic benefits.

The assistance and cooperation of the city of Hamilton; Pembina County Water Resource District; Pembina County Soil Conservation District; North Dakota State Water Commission; and private citizens in carrying out this study are appreciated.

HAMILTON FLOOD PLAIN MANAGEMENT STUDY

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U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

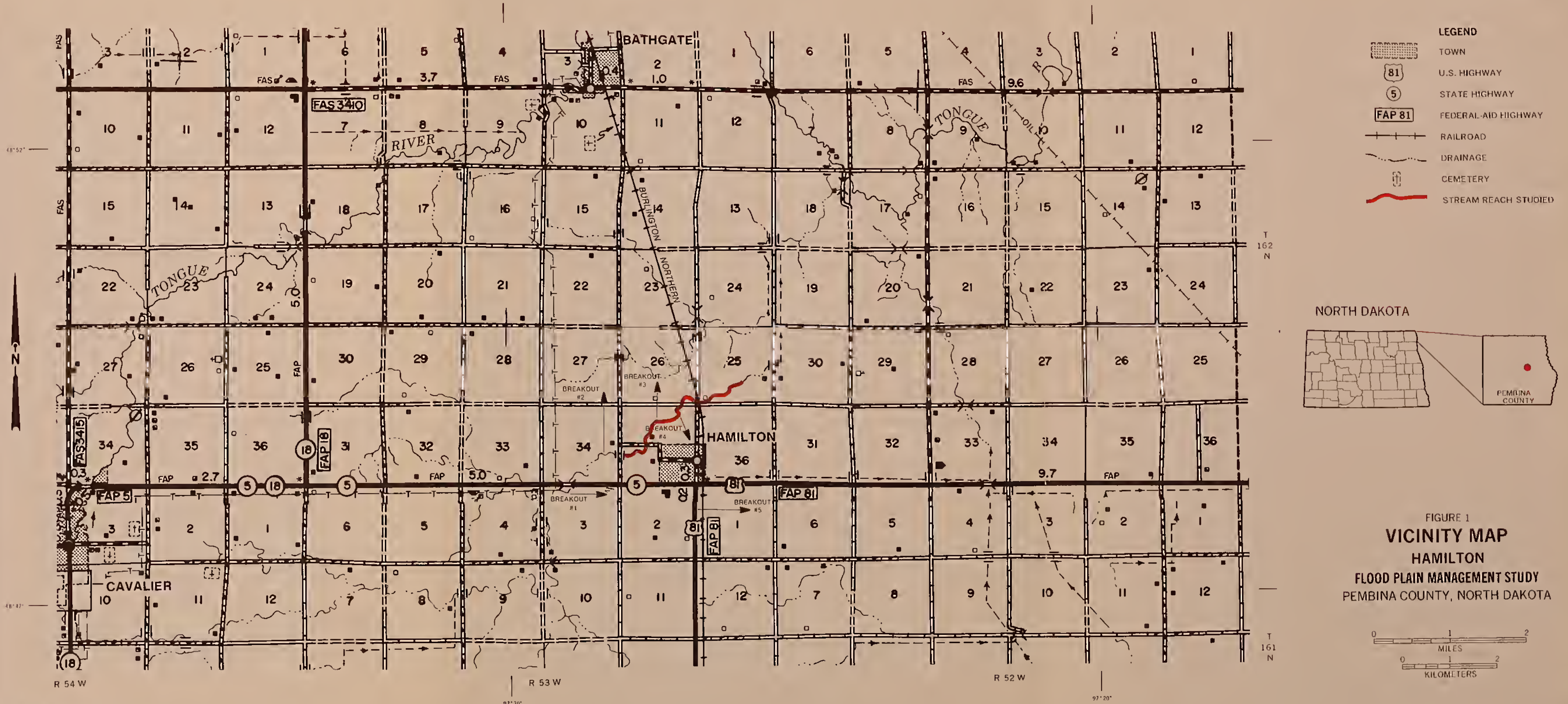


FIGURE 1

VICINITY MAP

HAMILTON

FLOOD PLAIN MANAGEMENT STUDY

PEMBINA COUNTY, NORTH DAKOTA

SOURCE:
1979 GENERAL HIGHWAY MAP AND
INFORMATION FROM SCS FIELD PERSONNEL
LAMBERT CONFORMAL PROJECTION

MAY 1986 4-R-39908.1

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX.-1986

INTRODUCTION

The purpose of this cooperative study is to identify flood hazard areas in and adjacent to the city of Hamilton, North Dakota, and provide technical data necessary to implement an effective local flood plain management program. Increasing pressure to develop flood plain areas is becoming apparent as competition for land grows. Land values and scarcity of undeveloped areas in which to expand often result in flood plain encroachment. Nonregulated development and encroachment frequently reduce flood conveyance, thereby increasing flood stages and overall flood losses.

Since the advent of federal laws governing financing within flood plains, many financial institutions are reluctant to lend unless there is assurance that the area is flood free or can be protected. Federal agencies cannot finance projects in unprotected flood prone areas.

It is imperative that flood plains in agricultural areas be defined so that the planning and location of valuable properties can be controlled and areas identified where future flood control measures can be applied.

This flood plain management study was requested by the Pembina County Water Resource District, city of Hamilton, and the Pembina County Soil Conservation District, through the North Dakota State Water Commission, under the 1978 Joint Coordination Agreement with the Soil Conservation Service. Priorities regarding such studies are set by the North Dakota State Water Commission. The study was carried out in accordance with the April 1984 Plan of Study between the Pembina County Water Resource District; city of Hamilton; Pembina County Soil Conservation District, the North Dakota State Water Commission; and the Soil Conservation Service.

This Flood Plain Management Study evaluates 2.19 miles of an unnamed tributary of the Tongue River.

The Study begins at the North-South quarter section line of Section 25, T. 162 N., R. 53 W. (Channel Mile 3.83) and proceeds upstream to the west section line of Section 35, T. 162 N., R. 53 W. (Channel Mile 6.02).

The "Extra Territorial Jurisdiction Law", passed by the 1975 North Dakota Legislature, provides communities with zoning authority outside the corporate limits. The 1981 North Dakota Legislature amended and re-enacted the law to include each quarter-quarter section within one-half mile of the corporate limits for incorporated cities with a population of 5,000 or less. The Extra Territorial Jurisdiction for the city of Hamilton is covered by this study.

Flood plain management studies carried out by the Soil Conservation Service result from recommendations found in A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress, second session), Recommendation 9(c), "Regulation of Land Use."

SCS assists state agencies and communities in the development, revision, and implementation of their flood plain management programs by carrying out cooperative flood plain management studies (FPMS's) in accordance with Federal Level Recommendation 3 of "A Unified National Program for Flood Plain Management," and Section 6 of Public Law 83-566. The principles contained in Executive Order 11988, Flood Plain Management, directs that "all executive agencies responsible for programs which entail land use planning shall take flood hazards into account when evaluating plans and shall encourage land use appropriate to the degree of hazard involved."

Potential users of flood plains should base planning decisions upon the advantages and disadvantages of each location. Potential flood hazards are often unknown and consequently the managers, potential users, and occupants cannot always accurately assess these risks. In order for a local flood plain management program to be effective in the planning, development and use of

flood plains, technical expertise is needed to collect, evaluate and interpret flood hazard data to help establish local flood plain management programs. SCS will:

1. Assist the state and local units of government by preparing appropriate technical information and interpretations for use in their flood plain management programs.

2. Provide technical services to managers of flood plain property for present and future land uses.

3. Improve basic technical knowledge about flood hazards in cooperation with other agencies and organizations.

This report contains aerial photomaps, water surface profiles and typical valley and channel cross sections indicating the extent of flooding which can be expected within the study areas. The 10-, 50-, 100- and 500-year frequency flood discharges and elevations are included. The hydraulic analyses for this study were based on unobstructed flow. The flow elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

The North Dakota State Water Commission or the Soil Conservation Service will, upon request, provide technical assistance to federal, state and local agencies and organizations in the interpretation and use of the information contained in this study.

DESCRIPTION OF STUDY AREA

The Flood Plain Management Study Area is located in the state of North Dakota Hydrologic Unit 09020313.

There is a large temperature range within the study area from summer to winter, and occasionally from day to day. In the winter, outbreaks of arctic air brings bitter cold. Most winters have many days with temperatures below

zero. The mean temperature for the winter months of December, January and February is 7.3°F. Summers are warm and pleasant with an average temperature of 66.7°F for the months of June, July and August. Average annual precipitation is 18.8 inches. June is usually the wettest month of the year, with an average precipitation of 3.0 inches.

The city of Hamilton is located in the Western Lake Section of the Central Lowland Province, an area characterized by a nearly level lacustrine plain that was formed in Glacial Lake Agassiz during the latter part of the Wisconsinan Age of the Pleistocene Epoch. The surface expression of the sediments is nearly flat to gently undulating with a general slope of about five feet per mile to the east and northeast.

An unnamed tributary to the Tongue River, with a drainage area of approximately 16 square miles, contributes runoff to the study area. This runoff flows through the west and north sides of the study area, through natural and manmade channels, and joins the Tongue River about 4 miles northeast of Hamilton.

NATURAL VALUES

"Flood plains, including their land and water ecosystems, have evolved from natural forces over tens of thousands of years. Yet, after two centuries of our Nation's history, the natural values of most of our flood plains have been significantly altered by human actions and in many cases degraded or destroyed. Thus, there is a national concern to carefully manage the remaining natural values of flood plains." 1/

The Hamilton Flood Plain Management Study consists of the flood plains and similar adjacent resource areas. The natural values discussion includes approximately 2.5 miles of stream channel and adjacent areas.

1/ See Reference 13.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

The study area consists of approximately 26% prime farmland, 64% prime farmland where drained, 4% additional farmlands of local importance, with the remaining 6% considered the Hamilton area of incorporation.

Natural beneficial flood plain values in the study area have been significantly affected by human actions in all but one location which is near a farmstead in the NW¼ of Section 35, T. 162 N., R. 53 W. There are additional values that have been added to the study area, such as woody and herbaceous plantings.

Characteristic native flood plain trees in the area might include species such as bur oak, green ash, boxelder, American elm, cottonwood, hackberry and basswood. Some of the common planted tree species might include Black Hills spruce, Colorado blue spruce, ponderosa pine, Rocky Mountain juniper, eastern red cedar, golden willow, American elm, Siberian elm, American plum, caragana, boxelder, Russian olive, lilac, green ash and hybrid poplars.

Breeding birds of the area include species such as mourning dove, eastern and western kingbirds, barn swallow, house wren, brown thrasher, robin, starling, grackle, yellow warbler, house sparrow, rock dove, song sparrow, ringnecked pheasant and partridge.

White-tailed deer frequent wooded areas and small mammals include fox squirrels, cottontails, and several species of mice, voles and shrews.

Flood plains in their natural or relatively undisturbed state provide three sets of natural and beneficial resources and hence resource values: (1) water resource values including natural moderation of floods, water quality maintenance, and groundwater recharge; (2) living resource values including large and diverse populations of plants and animals; and (3) cultural resource values including historical, archeological, scientific, recreational, and esthetic sites. 1/

1/ See Reference 13.

Flood plain natural values management and reestablishment should be considered in the study area. The following examples of practices would be beneficial to flood plain values.

1) Minimize flood plain fills.
2) Relocate structures out of the flood plain.
3) Restore and preserve natural drainage routes.
4) Prevent additional wetland destruction and channelization, restore damaged wetlands.
5) Support agricultural and urban practices that minimize water quality degradation such as controlled use of pesticides, herbicides and fertilizers.
6) Limit field size. Promote fence rows, field windbreaks and stripcropping.
7) Design structural upstream projects for runoff detention.
8) Reestablish damaged flood plain ecosystems.
9) Maintain existing riparian vegetation as a green belt.

The study area is not presently, nor is it proposed to be, listed in the National Wild and Scenic Rivers System. No critical habitat for threatened or endangered species was identified in the study area.

Cultural resource information indicates three site leads have been identified within the study area. All three sites occur in the SE¼ of Section 35, T. 162 N., R. 53 W., in Pembina County. They are listed as a historic-Hamilton townsite, Baptist Church (Hamilton), and Bank of Hamilton.

The 1978 Stream Evaluation Map - State of North Dakota does not classify the study stream. However, this stream empties into the Tongue River approximately 4 miles to the northeast which, at that point, is classified a value Class III - substantial fishery resource.

FLOOD PROBLEMS

Most of the flooding occurs in the spring of the year, usually in April. Flooding occurs due to spring runoff from a winter accumulation of snow and frozen soil conditions. Large floods in recent years occurred in 1948, 1950 and 1979.

Potential flood areas within the study area include residential, commercial, and agricultural land. Flood damages include eroded land, sediment deposition, crop damage, and weakened roads and bridges.

Upland agricultural drainage, restrictive bridges and limited channel capacity contribute to the severity of flooding within the study area.

Duration of flooding normally ranges from 7 to 14 days for significant flood events.

A 500-year frequency flood within the study area will inundate approximately 880 acres. A 100-year frequency flood will inundate approximately 730 acres. Flooding occurs in and around the city of Hamilton.

Figures 2 and 3 show potential flood stages within the study area.

FLOOD PLAIN MANAGEMENT

With flood hazard information, the community can minimize future flood losses by planning for the protection of existing structures within the flood plain area. Overall planning strategies for industrial, commercial and residential areas, streets, utilities, parks, and schools must recognize the need to develop outside the flood plain.

A coordinated planning procedure is a vital part of any comprehensive flood plain management program. Effective flood plain management involves public policy and action for the wise use and development of the flood plain. It also includes such measures as collection and dissemination of flood

control information, acquisition of flood plain lands, construction of control structures and enactment of statutes regarding flood plain land use and development.

A viable local flood plain management program is comprised of numerous elements, some of which are: structural flood control works to protect existing development; regulations to guide new development; flood insurance to protect existing and new buildings; and individual protection measures such as flood proofing.

Flood Control Measures

Various structural flood control measures to reduce the flooded area include enlarged bridge openings, dikes, floodways and channel work, or a combination of the above.

Flood Plain Regulations

Flood plain regulations are designed to permit realistic use of flood plain areas without increasing potential damage. Among the various elements used to accomplish this are zoning ordinances, subdivision regulations, building codes, and sanitary and utility regulations. For a guide, see "A Perspective on Flood Plain Regulations for Flood Plain Management", Corps of Engineers Manual EP 1165-2-304.

Flood Insurance

Under the National Flood Insurance Act of 1968 (PL 90-448), the Federal Emergency Management Agency (FEMA), Federal Insurance Administration (FIA), is authorized to carry out a National Flood Insurance Program (NFIP). This program makes flood insurance coverage available to all walled and roofed structures and their contents used for residential, business, religious and agricultural purposes; buildings occupied by nonprofit organizations; and

buildings owned by state or local governments or their agencies. The study area is currently eligible to participate in the National Flood Insurance Program. In participating areas, owners and occupiers of all buildings and mobile homes are eligible to obtain flood insurance coverage. It is recommended that persons within or adjacent to the delineated flood hazard areas maintain flood insurance on both the structure and contents.

Further inquiries about the flood insurance program should be directed to the Office of the State Engineer, North Dakota State Water Commission; the official state coordinating agency for flood insurance.

Other Measures

Land use and other regulatory controls including zoning, subdivision regulation and building codes play an important role in flood plain management. In order for these measures to be effective, it is important that the community takes action to implement other programs and measures to supplement these controls. A few possible measures to protect and control developments in flood prone areas are: (1) open space land acquisition programs, (2) urban renewal programs, (3) preferential tax assessment, (4) flood proofing of existing structures, and (5) public policy governing the construction of utilities and public facilities such as bridges and streets.

The Office of the State Engineer, upon request, will provide assistance in flood proofing techniques, the implementation of a flood warning system and establishment of a local flood data collection program.

Recommendations

Some specific recommendations for alleviating the flood situation within the study area are:

1. Adopt local land use and zoning regulations for all flood plain

areas. The basic purpose of flood plain regulations is to control development on the flood plain consistent with nature's needs for conveyance of flood flows.

2. Flood proof existing or future buildings that otherwise cannot be adequately protected. (See U.S. Army Corps of Engineers "Manual of Flood Proofing Regulations", EP 1165 2 314 and "Elevated Residential Structures Reducing Flood Damage Through Building Design: A Guide Manual", published by the Federal Insurance and Hazard Division, HUD).

3. Use as much of the flood hazard areas as possible for parks and other open space uses.

4. Improve bridge, culvert and channel hydraulic characteristics through enlargements and an active maintenance program consistent with environmental guidelines. Improving flow characteristics above breakout number 4 would increase peak flows into Hamilton unless adequate downstream capacity is provided.

5. Install a dike system to protect intensively developed flood plain areas such as residential, farmsteads, and other buildings. A dike to protect Hamilton would have a present construction cost in excess of $50,000.00 for a benefit/cost ratio less than 0.10:1, making the dike economically infeasible.

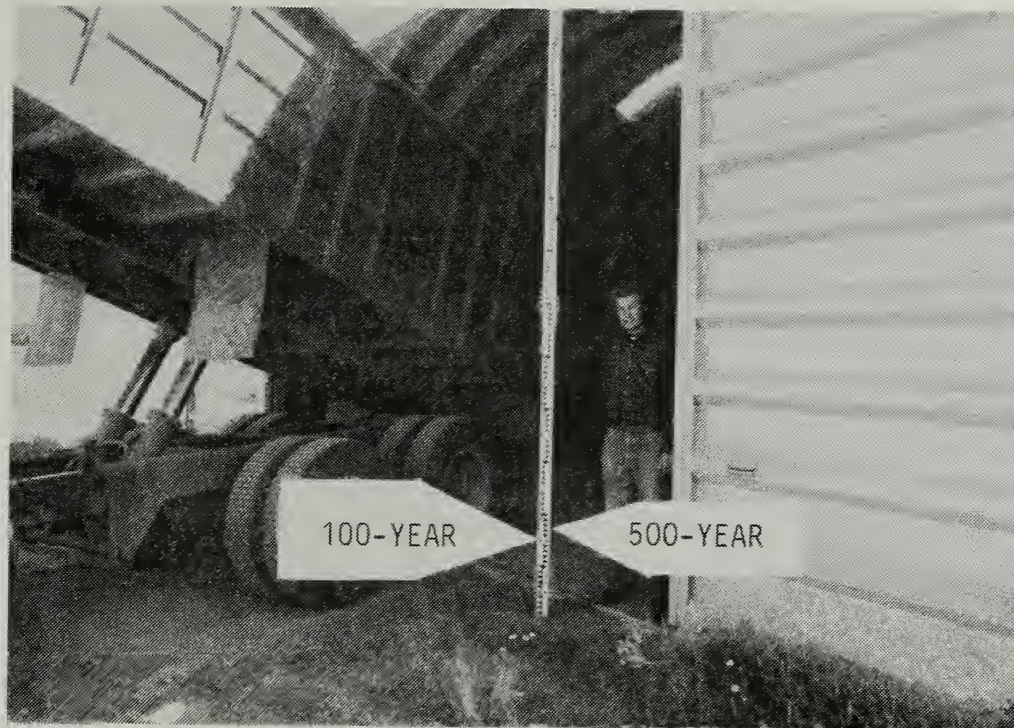


Figure 2 - Grain storage area in Hamilton

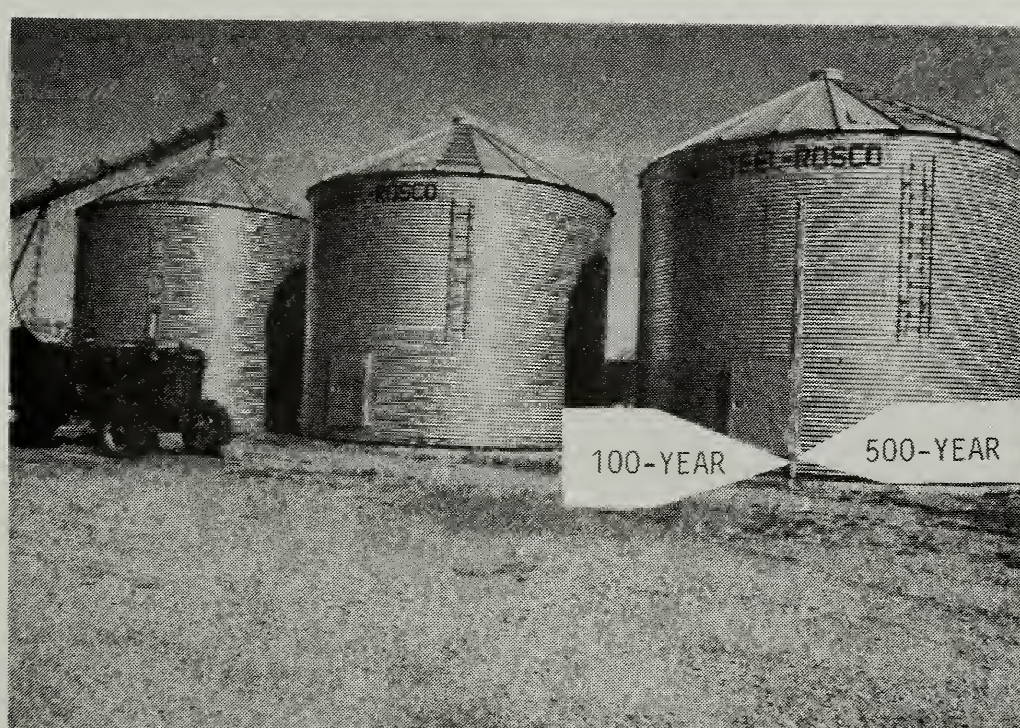


Figure 3 - Grain storage area in Hamilton

APPENDIX A

SOILS

The soil information in this report is for only the flood plain area. The soils of Pembina County are mapped, described, and interpreted in greater detail in the "Soil Survey of Pembina County, North Dakota." Copies of this survey and help in using soil information are available from the local Soil Conservation Service Office in Cavalier, North Dakota.

Interpretations are given in Table I (page 21) for a number of uses.

Yield Per Acre

The average yields of spring wheat that can be expected under a high level of management are shown in Table I. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

Yields are based on records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; proper planting and seeding rates; use of suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium, and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and timely harvesting that insures highest profits. Dashes indicated crops not grown or not suited to the soil.

Land Capability Classification

Land capability classification shows the general suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally

expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, woodland or engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass and unit. Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

Capability classes, the broadest groups, are designated by Roman Numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants, require special conservation practices or both.

Class III soils have severe limitations that reduce the choice of plants, require special conservation practices or both.

Class IV soils have very severe limitations that reduce the choice of plants, require very careful management or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils have limitations that essentially preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a small letter e, w, s, or c to the class numeral, for example, IIe.

The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; w shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); s shows that the soil is limited mainly because it is shallow, droughty, or stony; and c, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In Class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by w, s or c because the soils in Class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat or recreation.

Important Farmland

Prime farmland is one of several kinds of important farmlands defined by the U.S. Department of Agriculture. It is of major importance in providing the nation's short and long-range needs for food and fiber. Prime farmland is the land best suited to producing food, feed, forage, fiber and oilseed crops. Prime farmland may be in pasture, crops, woodland or other land but it is not urban or built-up land or water areas.

Additional Farmland of Statewide Importance (AFSI) is land, in addition to prime farmlands that is of statewide importance for the production of food, feed, fiber, forage, and oilseed crops. Generally, Additional Farmlands of Statewide Importance include those that are nearly prime farmland and that

economically produce high yields of crops when treated and managed according to acceptable farming methods. Some may produce as high a yield as prime farmlands if conditions are favorable.

Additional Farmlands of Local Importance are lands not designated prime or Additional Farmlands of Statewide Importance (AFSI) that can be protected from erosion and are capable of sustained production of the commonly grown crops. Additional Farmlands of Local Importance are designated by a unit of local government. The term "unit of local government" means the government of a county, municipality, town, township, village, or other unit of general government below the state level, or a combination of units of local government acting through an area-wide agency under state law or an agreement for the formulation of regional development policies and plans.

Soil Uses and Limitations

The soils are rated in Table I according to limitations that affect their suitability for playgrounds, picnic areas, dwellings with basements, septic tank absorption fields, sewage lagoons, fill materials for embankments and topsoil. The ratings are based on restrictive soil features such as wetness, slope and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, is the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, on site assessment of the height, duration, intensity and frequency of flooding is essential.

The degree of soil limitation is expressed as slight, moderate or severe. Slight means that soil properties are generally favorable and that limitations can be overcome or alleviated by planning, design or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use or by a combination of these measures.

Dwellings

Ratings are made for small dwellings with basements on undisturbed soil. The ratings are based on soil properties, site features and observed performance of the soils. A high water table, flooding, shrink-swell potential and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

Septic Tank Absorption Fields

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 to 72 inches is evaluated. The ratings are based on soils properties, site features and observed performance of the soils. Permeability, a high water table, depth to bedrock or a cemented pan, and flooding affect absorption of the effluent. Large stones and bedrock, or a cemented pan interfere with installation.

Playgrounds

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the

season of use. The surface is free of stones and boulders, is firm after rains and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

Picnic Areas

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use and do not have slopes, stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

Sewage Lagoons

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

The table gives ratings for the natural soil that makes up the lagoon floor. The surface layer and generally 1 to 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock and cemented pans can cause construction problems and large stones can hinder compaction of the lagoon floor.

Embankments, Dikes, and Levees

Embankments, dikes and levees are raised structures of soil material constructed to impound water or to protect land against overflow. In this table, the soils are rated as a source of fill material below the surface layer to a depth of about 5 feet. It is assumed that soil layers will be uniformly mixed and compacted during construction.

The ratings do not indicate the ability of the natural soil to support an embankment. Soil properties to a depth even greater than the height of the embankment can affect performance and safety of the embankment. Generally, deeper onsite investigation is needed to determine these properties.

Soil material in embankments must be resistant to seepage, piping and erosion, and have favorable compaction characteristics. Unfavorable features include less than 5 feet of suitable material and a high content of stones or organic matter, salts or sodium. A high water table affects the amount of usable material.

Topsoil

Topsoil is used to cover an area so that vegetation can be established and maintained. The upper 40 inches of a soil is evaluated for use as topsoil. Also evaluated is the reclamation potential of the borrow area.

Plant growth is affected by toxic material and by such properties as soil reaction, available water capacity and fertility. The ease of excavating, loading and spreading is affected by rock fragments, slope, water table, soil texture and thickness of suitable material. Reclamation of the borrow area is affected by slope, water table, rock fragments, bedrock and toxic material.

Soils rated good have friable loamy material to a depth of at least 40 inches. They are free of stones and cobbles, have little or no gravel and have slopes of less than 8 percent. They are low in content of soluble salts, are naturally fertile or respond well to fertilizer and are not so wet that excavation is difficult.

Soils rated fair are sandy soils; loamy soils that have a relatively high content of clay; soils that have only 20 to 40 inches of suitable material; soils that have an appreciable amount of gravel, stones, or soluble salts; or soils that have slopes of 8 to 15 percent. The soils are not so wet that excavation is difficult.

Soils rated poor are very sandy or clayey; have less than 20 inches of suitable material; have a large amount of gravel, stones or soluble salts; have slopes of more than 15 percent; or have a seasonal water table at or near the surface.

The surface layer of most soils is generally preferred for topsoil because of its organic matter content. Organic matter greatly increases the absorption and retention of moisture and nutrients for plant growth.

HAMILTON FLOOD PLAIN MANAGEMENT STUDY
PEMBINA COUNTY, NORTH DAKOTA
TABLE I: SOIL INTERPRETATIONS FOR SELECTED USES

Soil Symbol	Soil Name	Capability Class and Subclass	Important Farmland Category 1/ 2/	Spring Wheat Yield Bu/Ac 3/	Dwellings With Basements 1/ 4/	Septic Tank Absorption Fields 1/	Playgrounds 1/	Picnic Areas 1/	Sewage Lagoons 1/ 4/	Dikes, Levees, Embankments 1/	Topsoil 1/
BnA	Bearden silty clay loam, 1 to 3 percent slopes	IIe	P	42	Severe: Wetness	Severe: Wetness, Percs Slowly	Moderate: Wetness	Moderate: Wetness Percs Slowly	Severe: Wetness	Moderate: Piping Hard to Pack, Wetness	Fair: Too Clayey
BrA	Bearden silty clay loam, saline 1 to 3 percent slopes	IIIs	AFLI	29	Severe: Wetness	Severe: Wetness, Percs Slowly	Severe: Excess Salt	Severe: Excess Salt	Slight	Severe: Piping	Poor: Excess Salt
BvA	Bearden and Glyndon silt loams, 1 to 3 percent slopes		P	43							
	Bearden	IIe			Severe: Wetness	Severe: Wetness, Percs Slowly	Moderate: Wetness,	Moderate: Wetness Percs Slowly	Severe: Wetness	Moderate: Piping, Hard to Pack, Wetness	Good
	Glyndon	IIe			Moderate: Wetness	Severe: Wetness	Slight	Slight	Severe: Seepage, Wetness	Severe: Piping	Fair: Thin Layer
Cn	Colvin silty clay loam	IIw	PWD	32	Severe: Wetness	Severe: Wetness Percs Slowly	Severe: Wetness	Severe: Wetness	Severe: Wetness	Severe: Wetness	Poor: Wetness
FaB	Fairdale silty clay loam, 3 to 6 percent slopes	IIe	P	36	Severe: Flooding	Severe: Flooding	Severe: Flooding	Moderate: Flooding	Severe: Flooding	Severe: Piping	Good
GfA	Glyndon silt loam, 1 to 3 percent slopes	IIe	P	42	Moderate: Wetness	Severe: Wetness	Slight	Slight	Severe: Seepage, Wetness	Severe: Piping	Fair: Thin Layer
HmA	Hegne-Fargo silty clays, 1 to 3 percent slopes		PWD	36							
	Hegne	IIw			Severe: Wetness, Shrink-Swell	Severe: Wetness, Percs Slowly	Severe: Too Clayey Wetness, Percs Slowly	Severe: Too Clayey Percs Slowly	Slight	Severe: Hard to Pack, Wetness	Poor: Too Clayey
	Fargo	IIw			Severe: Wetness, Shrink-Swell	Severe: Wetness, Percs Slowly	Severe: Too Clayey, Wetness	Severe: Wetness, Too Clayey	Slight	Severe: Hard to Pack, Wetness	Poor: Wetness, Too Clayey
LrA	La Prairie silty clay loam, 1 to 3 percent slopes	IIc	P	45	Severe: Flooding	Severe: Flooding, Wetness	Severe: Flooding	Moderate: Flooding	Severe: Flooding	Moderate: Piping, Wetness	Good
Pu	Perella silty clay loam	IIw	PWD	45	Severe: Ponding	Servere: Ponding, Percs Slowly	Severe: Ponding	Severe: Ponding	Severe: Ponding	Severe: Piping, Ponding	Poor: Wetness

1/ Soil Interpretations Pembina County, North Dakota prepared by USDA SCS, 1977.

2/ P=prime, PWD=prime where drained, AFLI=additional farmlands of local importance.

3/ All yields are for drained areas of the poorly drained and very poorly drained soils.

4/ Construction of dwellings, septic tanks and sewage lagoons is not recommended in the flood plain. However, if construction is necessary the developer should consider the flood hazard and soil restrictions presented in this report.

FLOOD HAZARD AREA PHOTOMAPS

APPENDIX B

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

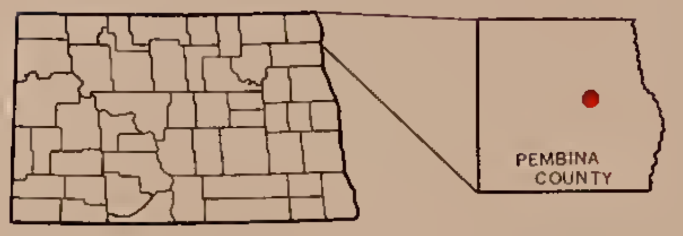
LEGEND

1 SHEET COVERAGE

FLOOD PLAIN AREA (100 AND 500 YEAR FREQUENCY FLOODS)

STREAM CHANNEL

NORTH DAKOTA



INDEX TO MAP SHEETS

HAMILTON

FLOOD PLAIN MANAGEMENT STUDY

PEMBINA COUNTY, NORTH DAKOTA

SCALE 0 ¼ ½ ¾ 1 MILE

0 ½ 1 KILOMETER

APPROXIMATE

SOURCE:
MAY 1985 AERIAL PHOTOGRAPHY FROM KBM, INC.
AND INFORMATION FROM SCS FIELD PERSONNEL

JULY 1986 4-R-39908 2

USDA-SCS-NATIONAL CARTOGRAPHIC CENTER, FT. WORTH, TX-1986

LEGEND

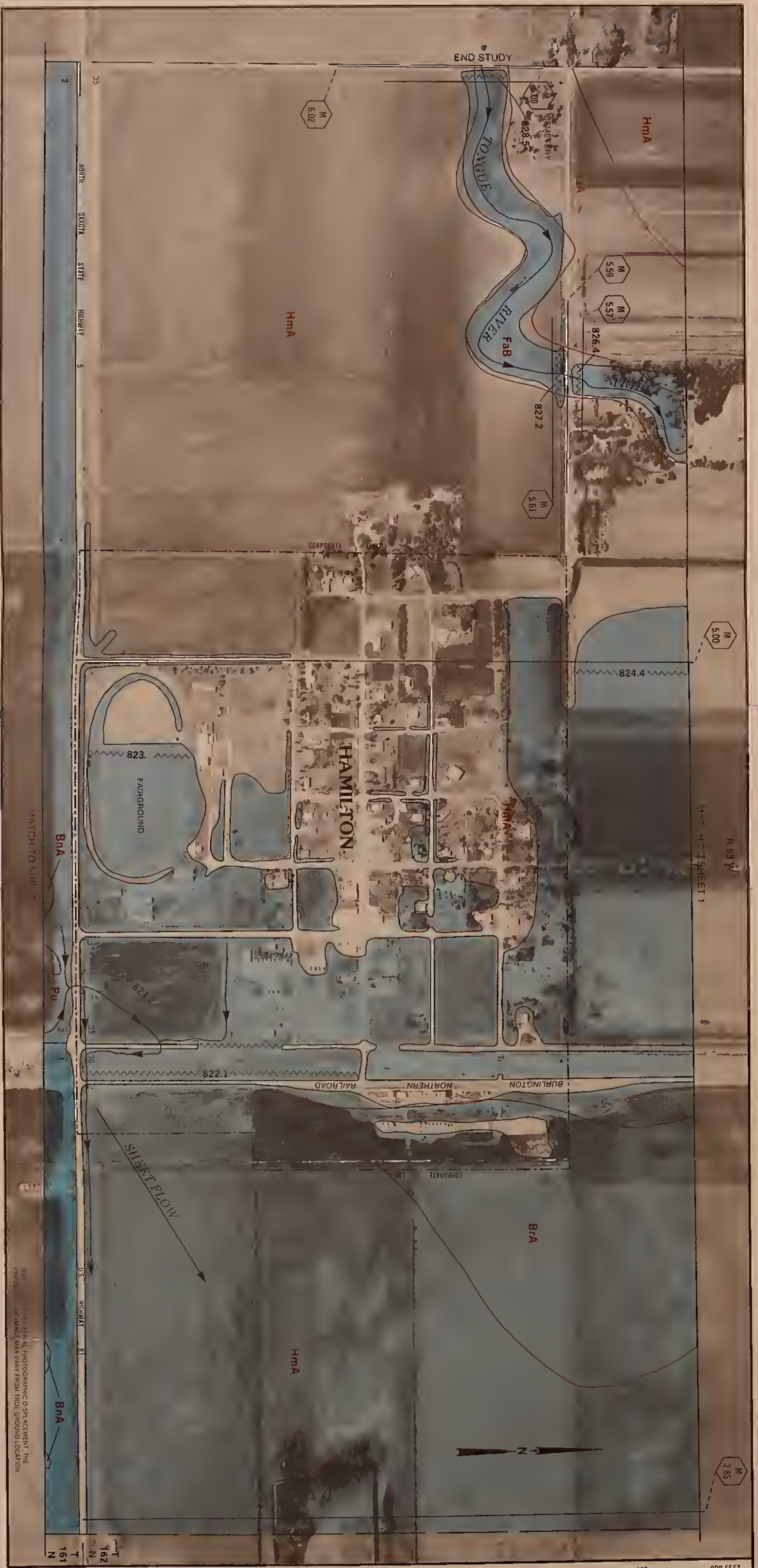
100 Year Flood Hazard Area	M 3.83 Valley Section	BnA Soils Area & Symbols
500 Year Flood Hazard Area	823.4 Estimated 100-Year Flood Elevation	
Stream Channel		

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

Source:
May 1985 Aerial Photography From KBM, Inc.
And Information From SCS Field Personnel

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE HAMILTON FLOOD PLAIN MANAGEMENT STUDY AREA PEMBINA COUNTY, NORTH DAKOTA	FLOOD HAZARD AREA HAMILTON

SHEET 1 OF 3



LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Stream Channel

M 3.83 Valley Section

823.4 Estimated 100-Year Flood Elevation

BrA Soils Area & Symbols

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

Source
May 1985 Aerial Photography From KBM, Inc.
And Information From SCS Field Personnel

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
HAMILTON
FLOOD PLAIN MANAGEMENT STUDY AREA
PEMBINA COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

HAMILTON

SHEET 2 OF 3

JULY 1986 4-R 39908

LEGEND

100 Year Flood Hazard Area

500 Year Flood Hazard Area

Stream Channel

M 3.83 Valley Section

823.4 Estimated 100-Year Flood Elevation

GfA Soils Area & Symbols

SCALE 0 400 800 FEET
0 100 200 METERS
APPROXIMATE

Source:
May 1985 Aerial Photography From KBM, Inc.
And Information From SCS Field Personnel

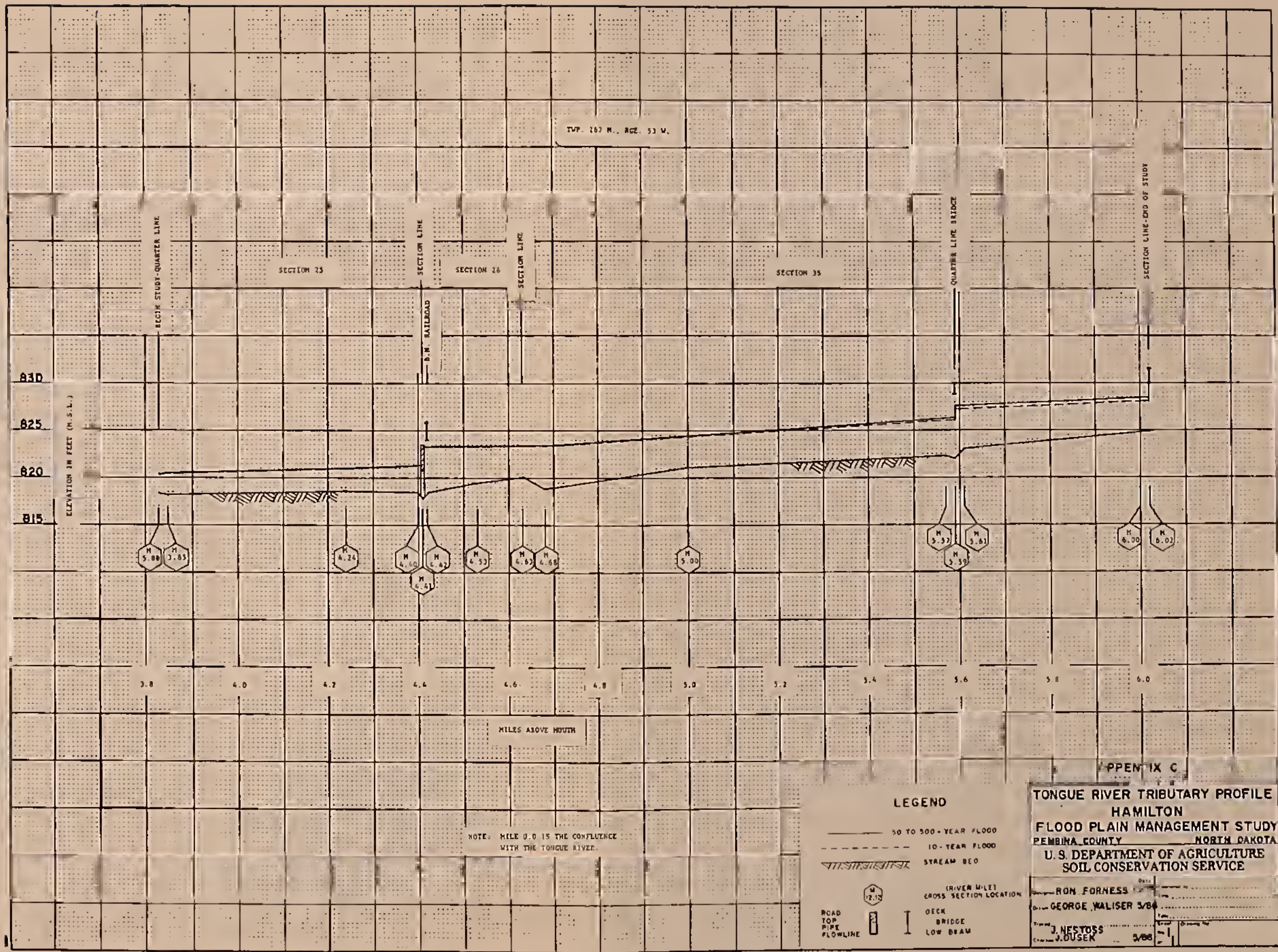
SHEET 3 OF 3

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
HAMILTON
FLOOD PLAIN MANAGEMENT STUDY AREA
PEMBINA COUNTY, NORTH DAKOTA

FLOOD HAZARD AREA

HAMILTON

JULY 1986 4-R-39908



TWP. 162 N., RGE. 53 W.
BEGIN STUDY-QUARTER LINE
SECTION 25
SECTION LINE
B.N. RAILROAD
SECTION 26
SECTION LINE
SECTION 35
QUARTER LINE BRIDGE
SECTION LINE-END OF STUDY
830
825
820
815
ELEVATION IN FEET (M.S.L.)
3.80
3.85
4.24
4.40
4.41
4.42
4.53
4.63
4.68
5.00
5.57
5.59
5.61
6.00
6.02
3.8
4.0
4.2
4.4
4.6
4.8
5.0
5.2
5.4
5.6
5.8
6.0
MILES ABOVE MOUTH
NOTE: MILE 0.0 IS THE CONFLUENCE WITH THE TONGUE RIVER.
LEGEND
50 TO 500-YEAR FLOOD
10-YEAR FLOOD
STREAM BED
(RIVER MILE) CROSS SECTION LOCATION
ROAD TOP PIPE FLOWLINE
DECK BRIDGE LOW BEAM
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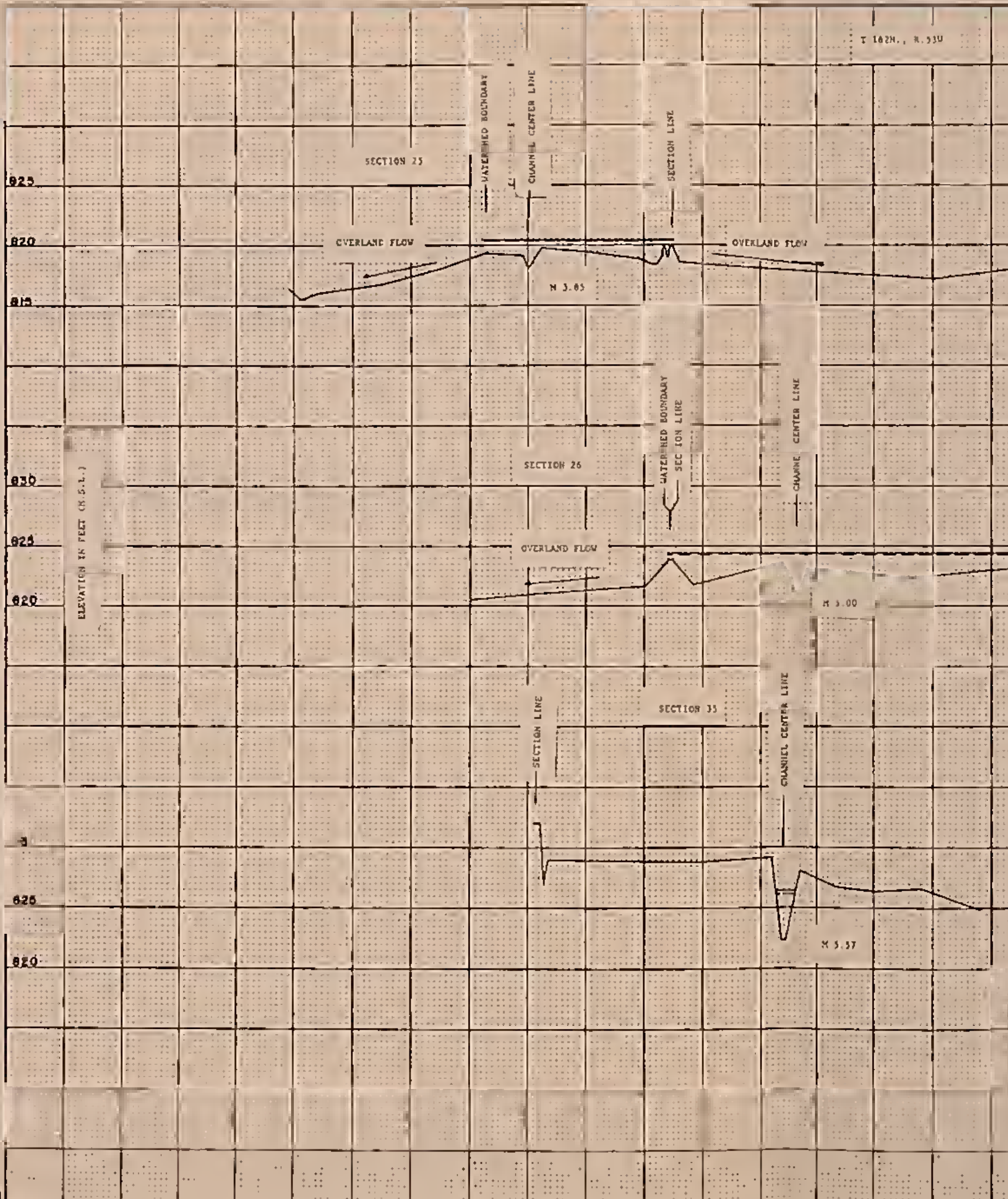
TONGUE RIVER TRIBUTARY PROFILE
HAMILTON
FLOOD PLAIN MANAGEMENT STUDY
PEMBINA COUNTY NORTH DAKOTA
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
RON FORNESS
GEORGE WALISER 5/86
J. NESTOSS
J. DUSEK 5/86



PP NDIX D

SAMPLE CROSS-SECTIONS
TONGUE RIVER TRIBUTARY
HAMILTON
FLOOD PLAIN MANAGEMENT STUDY
PEMBINA COUNTY NORTH DAKOTA

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

R. D. Forness 5/86
G. F. Wollser 6/86
J. E. NESTOSS 6/86

APPENDIX E

DISCHARGE-FREQUENCY DATA

TONGUE RIVER TRIBUTARY

PEMBINA COUNTY

BETWEEN RIVER MILES	DRAINAGE AREA (SQUARE MILES)	500-YEAR FREQ. FLOOD Q (CFS)	100-YEAR FREQ. FLOOD Q (CFS)	50-YEAR FREQ. FLOOD Q (CFS)	10-YEAR FREQ. FLOOD Q (CFS)
TONGUE RIVER					
3.83					
	16.5	1,300	950	750	450
6.02					
PEAK DISCHARGE DUE TO BREAKOUT AREAS					
3.83					
	16.5	150	150	150	150
4.68					
	16.5	300	300	300	285
5.00					
	16.5	500	500	500	410
6.02					

APPENDIX F

WATER SURFACE ELEVATION - FREQUENCY DATA

TONGUE RIVER TRIBUTARY

PEMBINA COUNTY

EXISTING CONDITION				
RIVER MILE 1/	500-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	100-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	50-YEAR FREQ. FLOOD ELEVATION (M.S.L.)	10-YEAR FREQ. FLOOD ELEVATION (M.S.L.)
3.83	820.4	820.4	820.4	820.4
3.85	820.5	820.5	820.5	820.5
4.24	821.0	821.0	821.0	821.0
4.40	821.3	821.3	821.3	821.3
4.41	823.4	823.4	823.4	823.4
4.42	823.4	823.4	823.4	823.4
4.53	823.4	823.4	823.4	823.4
4.63	823.5	823.5	823.5	823.5
4.68	823.5	823.5	823.5	823.5
5.00	824.4	824.4	824.4	824.3
5.57	826.4	826.4	826.4	826.2
5.59	827.7	827.7	827.7	827.3
5.61	827.7	827.7	827.7	827.3
6.00	828.5	828.5	828.5	828.1

1/ Channel mile 0.0 is at the confluence of the Tongue River.

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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APPENDIX G

INVESTIGATION & ANALYSES

Surveys

A bench mark circuit was established throughout the study area using existing U.S.G.S. Coast and Geodetic Bench Marks. Elevation reference marks are scattered throughout the study area. These reference marks can be used to determine flood elevations as indicated in this flood hazard analyses. Detailed locations, descriptions and elevations can be obtained from Appendix J. Third order levels were used as the base of accuracy in field surveys.

A total of 21 channel and flood plain cross sections, covering a channel mile distance of 3.76 miles, were analyzed. Surveys were continued upstream of the study area to accurately determine the peak flows entering the study area.

The geometry of all bridges and culverts was measured and used in computing the water surface profiles.

All cross sections within the study area are located on the photomaps (Appendix B, Sheets 1 to 3).

Photogrammetry

High level aerial photography flights were flown in May 1985. This photography was used for compilation of the final photo maps. Field surveyed cross sections were used to compute water surface profiles for the 10-, 50-, 100- and 500-year floods. The 100-year and 500-year curvilinear flood boundaries were field mapped using elevations computed from water surface profiles.

Hydrology and Hydraulics

Peak discharges for the 10-, 50-, 100-, and 500-year frequencies were determined by procedures contained in Soil Conservation Service National Engineering Handbook, Section 4 and Technical Release 20.

Peak discharges varied throughout the study area depending on the amount of flow leaving the study area at the various breakouts.

The drainage area used to determine peak discharges is 16.5 square miles.

Water surface elevations for the 10-, 50-, 100- and 500-year flood events were computed using the U.S. Soil Conservation Service WSP-2 computer program, which performs subcritical backwater computations by a modified step method. The program includes head loss computations at restrictive sections such as roadway bridge openings or culverts, using the US Bureau of Public Roads Method.

Roughness coefficients (Manning's "n") used in the hydraulic computations were chosen using U.S. Soil Conservation Service guidelines. The channel value selected was 0.045, while the flood plain value ranged from 0.065 to 0.085.

Starting water surface elevations were computed using downstream watershed slope.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in the study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly and do not fail.

The 100-year flood was computed to emphasize the effect of constrictions (bridge openings) on flooding and provide a basis for analyzing future improvements. Future projections indicate that expected encroachment will affect the

flood stages a slight amount within the study area. The 100-year flood also serves as the base flood which FEMA considers as a minimum for flood insurance requirements.

Breakout Areas

Five breakout or overflow areas were identified in the flood hazard analysis. The five areas and their maximum capacities are as follows:

(a) Breakout #1 is located at the bridge between Section 34, T. 162 N., R. 53 W. and Section 3, T. 161 N., R. 53 W. (Mile 7.19). The maximum capacity of the bridge at this location is 750 cfs. Flows in excess of 750 cfs flow overland towards the junction of Highways 5 and 81.

(b) Breakout #2 is located at Mile 6.02. Flows in excess of the bridge capacity (500 cfs) overflow to the north and exit the study area in the NE corner of Section 34, T. 162 N., R. 53 W.

(c) Breakout #3 is located at Mile 5.00. Flows greater than 300 cfs begin overflowing to the north and exit the study area in the NW¼, Section 35, T. 162 N., R. 53 W.

(d) Breakout #4 is located at Mile 4.68. Channel capacity is approximately 140 cfs. Flows in excess of 140 cfs overflow to the south and enter the city of Hamilton. Based on the maximum capacity of Breakout #3, the maximum discharge overflowing into the city of Hamilton should be approximately 160 cfs (300-140).

(e) Breakout #5 is located at the junction of Highways 5 and 81. Flows reaching this point consist of overflows from Breakout #1 plus approximately 1100 acres of local drainage. Flows less than 200 cfs pass through the box culvert under Highway 5 and contribute to flooding in the city of Hamilton. Flows over 200 cfs pass over Highway 81 and out of the study area.

Flooding Within the City of Hamilton

Flows contributing to flooding in the city were determined to be the combination of overflows from Breakouts 4 and 5 plus local drainage from within the city (approximately 200 acres). These flows are estimated to be:

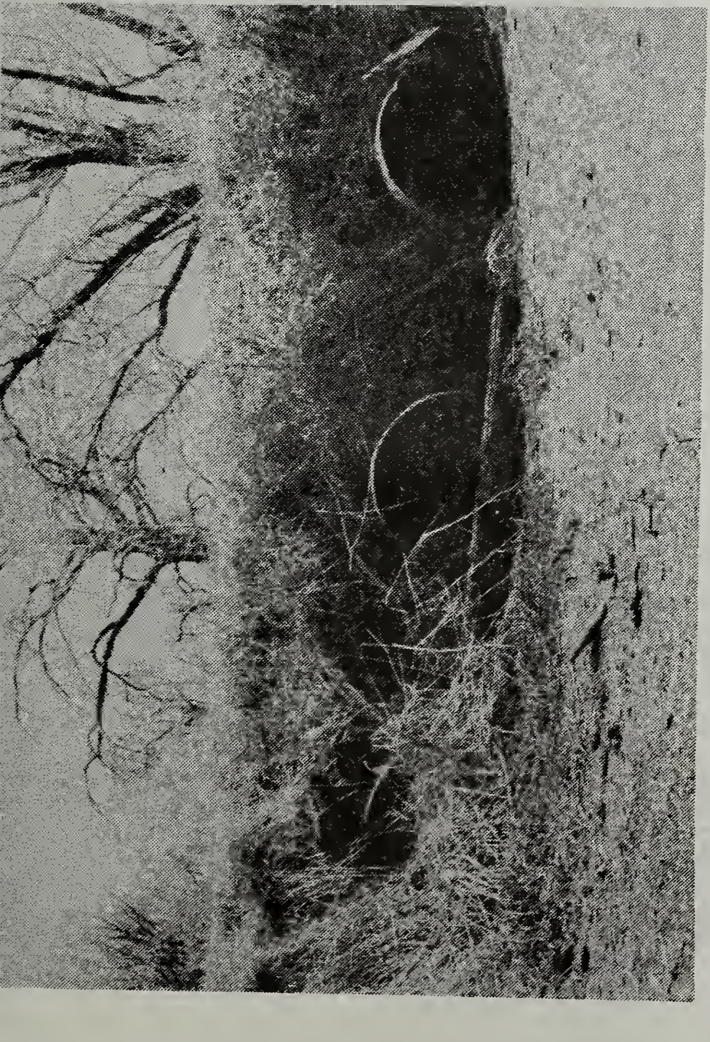
10 yr flood	325 cfs
50 yr flood	450 cfs
100 yr flood	470 cfs
500 yr flood	525 cfs

APPENDIX H

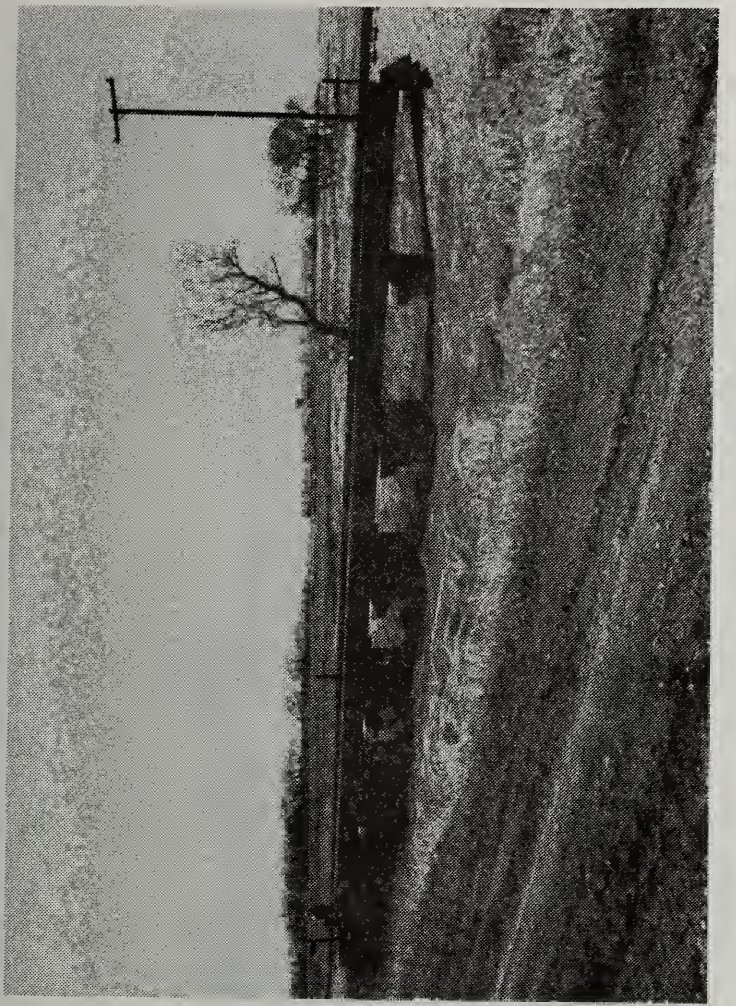
EXISTING BRIDGES AND CULVERTS

Bridges and culverts existing at the time of study and used to develop the water surface profile data contained in this document are shown pictorially on the following pages.

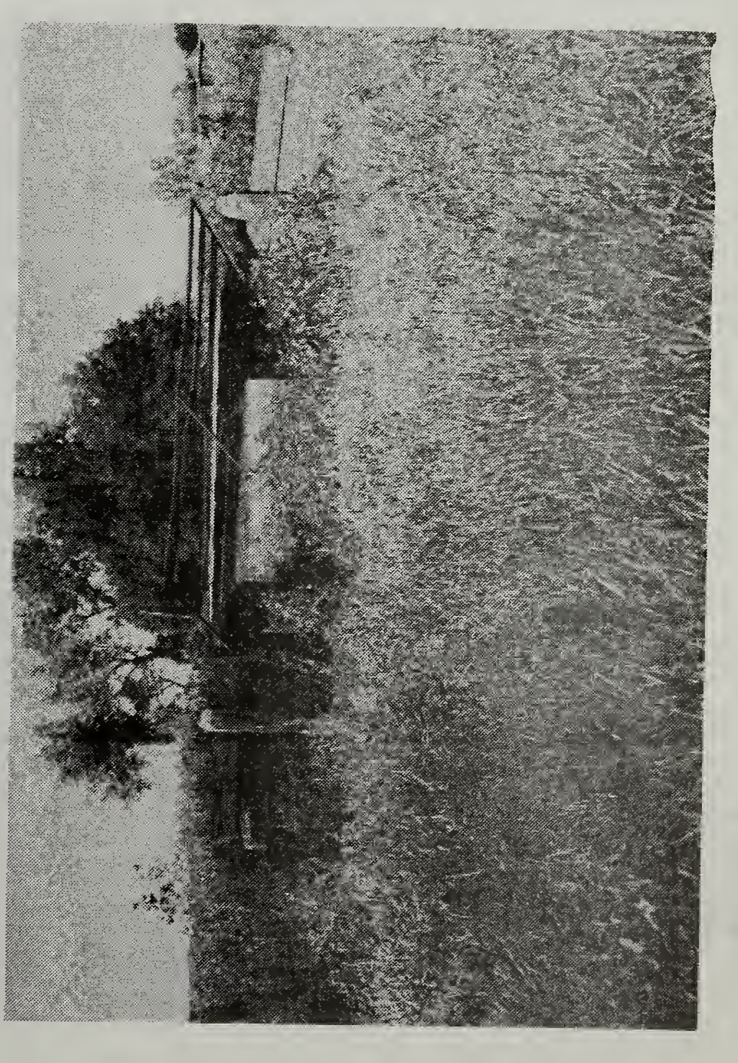
The pictures should be helpful in the future to visually check which bridges were in place at the time of study, which were restrictive or in need of replacement and which have been subsequently replaced thus affecting localized flood plains.



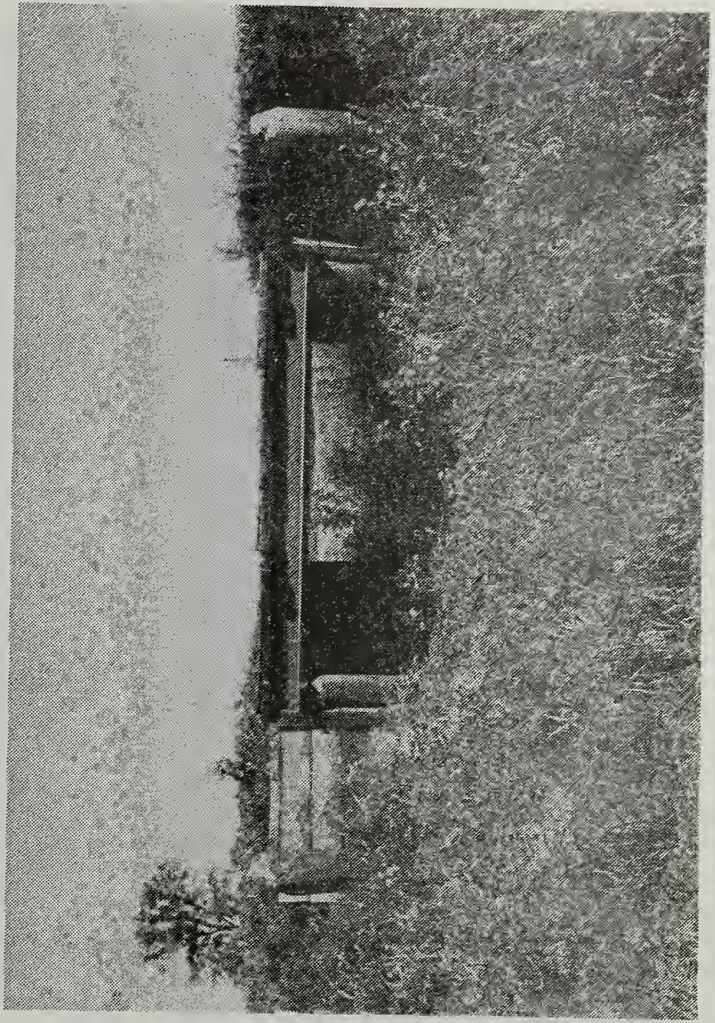
M 4.40 Sections 25 and 26, T. 162 N., R. 53 W.



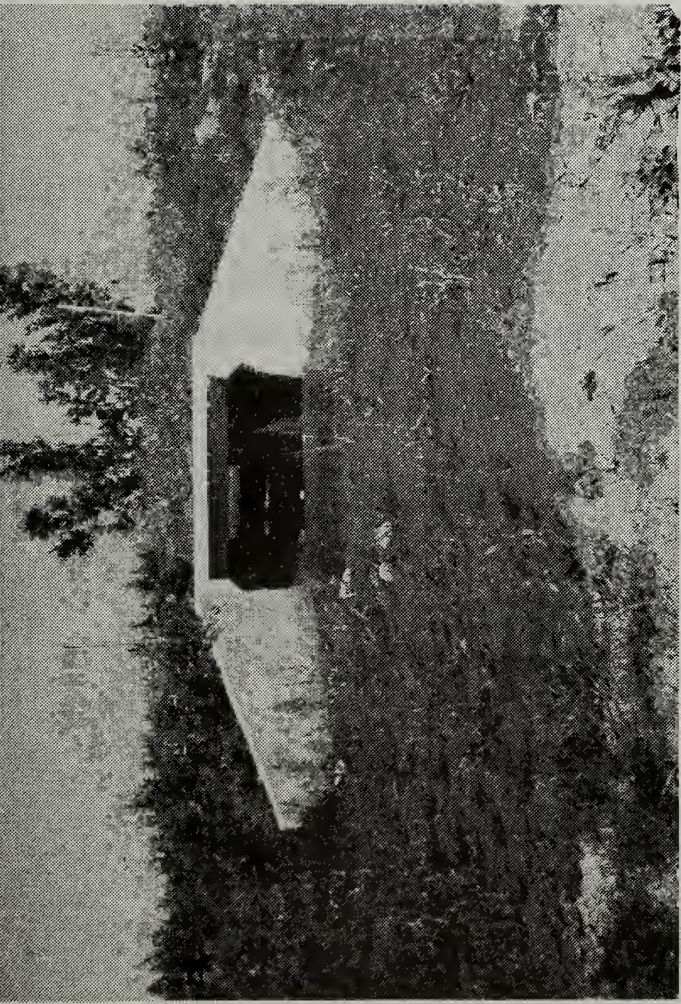
M 4.42 B.N. Railroad bridge in Section 26.



M 5.59 Quarter line bridge in Section 35
T. 162 N., R. 53 W.

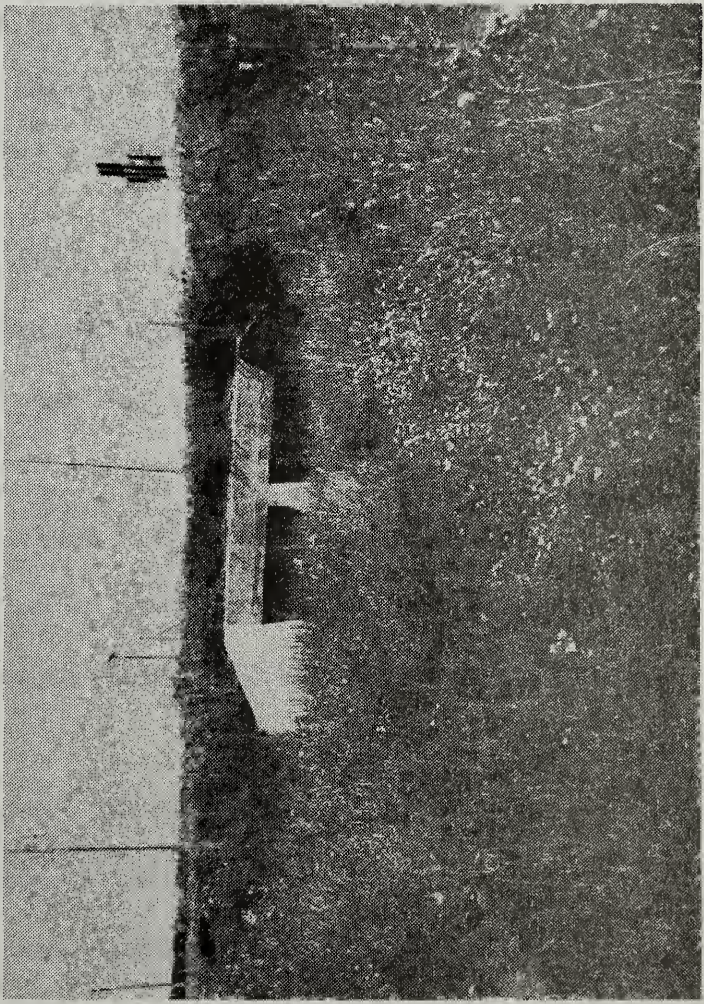


M 6.02 Sections 34 and 35, T. 162 N., R. 53 W.

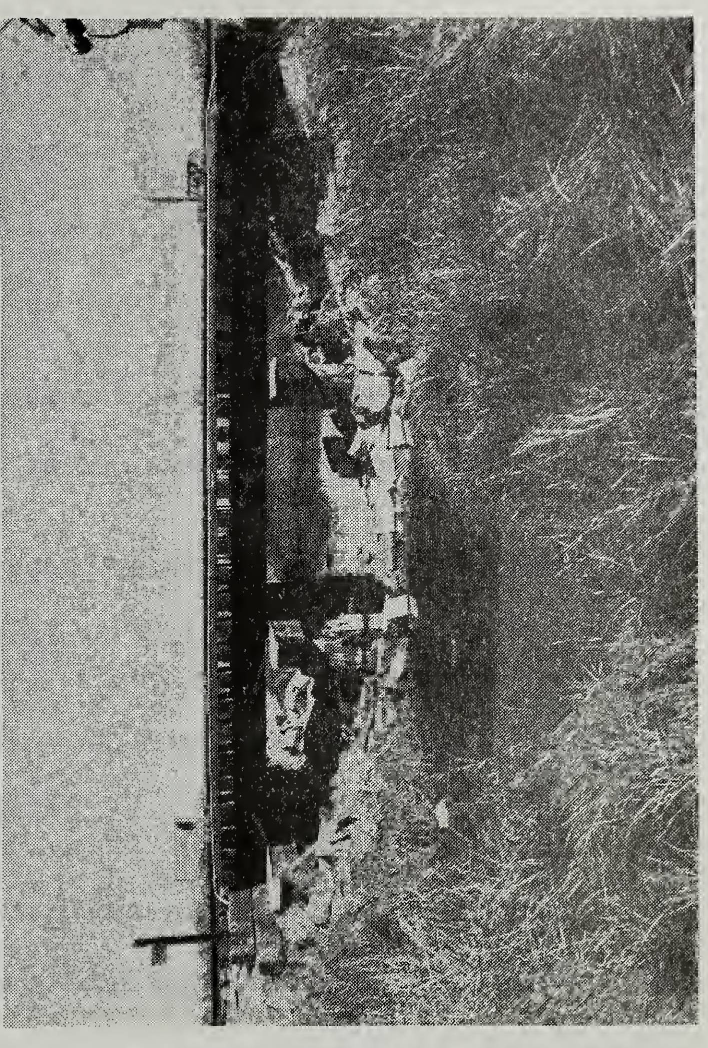


Box culvert through Highway 5 near the SE corner of Section 35, T. 162 N., R. 53 W.

Bridge near the SE corner of Section 35, T. 162 N., R. 53 W.



Box culvert at the SE corner of Section 35, T. 162 N., R. 53 W.



Railroad bridge near the SW corner of Section 36, T. 162 N., R. 53 W.

APPENDIX I

GLOSSARY

Acre-Foot -- The amount of water that will cover one acre to a depth of one foot. Equals 43,560 cubic feet.

Backwater -- The resulting high water surface in a given stream due to a downstream restriction or high stages in an intersecting stream.

Channel -- A natural or artificial watercourse with definite bed and banks to confine and conduct continuously or periodically flowing water.

Cubic Feet Per Second -- Rate of fluid flow at which one cubic foot of fluid passes a measuring point in one second (cfs).

Discharge -- The rate of flow or volume per unit of time. In this report discharge is expressed in cubic feet per second (cfs).

Flood -- An overflow of water onto lands not normally covered by water. The inundation is temporary and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake or other body of standing water.

Flood Frequency -- An expression of how often a flood event of a given magnitude will, on the average, be equaled or exceeded. The word "frequency" often is omitted in discussing a flood event for the purpose of abbreviation.

Examples"

10-year flood or 10-year frequency flood - the flood which can be expected to be equaled or exceeded on an average of once in 10 years; and which would have a 10 percent chance of being equaled or exceeded in any given year.

50-year flood - ...two percent chance...in any given year.

100-year flood - ...one percent chance...in any given year.

500-year flood - ...two-tenths percent chance...in any given year.

Flood Peak or Peak Discharge -- The highest stage or discharge attained during a flood.

Flood Plain, Flood Prone Area or Flood Hazard Area -- Land adjoining a stream (or other body of water) which may be temporarily covered by flood water.

Flood Plain Encroachment -- Placement of fill or structures in the flood plain which may impede flood flow and cause backwater.

Flood Proofing -- A combination of structural provisions, changes or adjustments to properties and structures subject to flooding for the reduction or elimination of flood damages to properties, water and sanitary facilities, structures and contents of buildings in a flood hazard area.

Flood Routing -- Computation of the changes in streamflow as a flood moves downstream. The results provide hydrographs of discharge versus time at given points on the stream.

Flood Stage -- The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area.

Hydrograph -- A plotted curve showing the rise and fall of flood discharge with respect to time at a specific point on a stream.

Natural Storage Area -- In this report, refers to depressional areas, marshes, lakes and swamps that temporarily store a portion of the surface runoff.

Natural Values -- Values existing in a area untouched by the influences of civilization and society.

Riparian Land -- Land situated along the bank of a stream or other body of water.

Runoff -- In this report, refers to the portion of precipitation (including snowmelt) that flows across the land surface and contributes to stream or flood flow.

Stage Discharge Curve -- A plotted curve showing the variation of discharge with water surface elevation at a point on a stream.

Stage-Storage Curve -- A plotted curve showing the accumulated storage available for floodwater upstream from a point on a stream versus the stage at that point.

Valley Cross Section -- The relationship of the elevation of the ground to the horizontal distance across a valley perpendicular to the direction of flow.

Watershed -- A drainage basin or area which collects and transmits runoff to the outlet of the basin.

Watershed Boundary or Drainage Boundary -- The divide separating one watershed from another.

Water Surface Profile -- The relationship of water surface elevation to stream channel elevation at points along a stream, generally drawn to shown the water surface elevation for the peak of a specific flood, but may be prepared for conditions at any given time.

APPENDIX J

ELEVATION REFERENCE MARKS

HAMILTON FLOOD PLAIN MANAGEMENT STUDY

R.M. No.	Elevation (MSL)	R.M.'s Description
4	820.90	On top of a railroad spike in the west end of the south stringer on a railroad bridge near the southwest corner of Section 36, T. 162 N., R. 53 W.
6	823.86	On top of a railroad spike in the east end of the south stringer on a railroad bridge near the southeast corner of Section 26, T. 162 N., R. 53 W.
8	829.82	On top of a railroad spike in piling at the northwest corner of a bridge on the township road on the quarter line in Section 35, T. 162 N., R. 53 W.
9	830.50	On top of a railroad spike in piling at the southeast corner of a bridge between Sections 34 and 35, T. 162 N., R. 53 W.

APPENDIX K

BIBLIOGRAPHY AND REFERENCES

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2. Guidelines for Determining Flood Flow Frequency. Bulletin #17A of the Hydrology Committee, Rev. June 1977. U.S. Water Resources Council. Washington, D.C.

3. Water Resources Data for North Dakota. Annual Reports. U.S. Geological Survey. Water-Data Report.

4. Extra Territorial Jurisdiction. North Dakota Century Code. Section 40-47-01. 1975.

5. Water Resources Council, United States. Regulation of Flood Hazard Areas, Vols. 1 and 2. Washington, D.C.: United States Government Printing Office, 1971 and 1972.

6. A Perspective on Flood Plain Regulations for Flood Plain Management. Department of the Army, Office of the Chief of Engineers, Washington, D.C. 1976.

7. Flood Proofing Regulations. DOA, OCE, Washington, D.C., 1972.

8. A Report by the Task Force on Federal Flood Control Policy, House Document No. 465 (89th Congress, Second Session).

9. Public Law 83-566 Watershed Protection and Flood Prevention Act.

10. Executive Order No. 11988, May 24, 1977, Flood Plain Management.

11. Soil Survey of Stark County, North Dakota, Published by the USDA Soil Conservation Service and in cooperation with the North Dakota Agricultural Experiment Station, February 1968.

12. National River Basins Bulletin No. 15-0-6 of February 22, 1980.

13. Resource Conservation Glossary, 1976, Soil Conservation Society of America.

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SOIL CONSERVATION SERVICE